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Neutrino-nucleus cross sections and their role in supernovae[1]

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Interactions between neutrinos and nuclei play a crucial role in core-collapse supernovae. The intense neutrino flux carries away 99% of the total energy released in the explosion. The dynamics of core collapse and formation (and propagation) of the shock in supernova models are sensitive to the rates used for interactions of neutrinos (and electrons) with nuclei. The distribution of isotopes that are synthesized and ejected into the interstellar medium is also influenced by neutrino-nucleus interactions. Terrestrial measurements of the neutrino spectra from a nearby supernova could give valuable information, but the interpretation of such measurements can be improved by better understanding of the neutrino interactions in the detector material. Neutrino interactions at energies relevant for supernovae (tens of MeV) are quite dependent on the structure of the nucleus. Accurate cross section measurements have been made on only one nucleus, ^{12}C. The reliability of theoretical models for cross sections is uncertain and is likely to depend upon the quality of available nuclear structure information. A collaboration, *νSNS*, has recently proposed to build a facility for measurements of neutrino-nucleus cross sections at the Spallation Neutron Source (SNS), currently under construction at ORNL. Detectors for *νSNS* have been designed to be resued for multiple nuclear targets. The charged-current cross section for any particular target could be measured with 10% accuracy in less than one year of operation with a 20-ton instrument. The role of neutrino-nucleus interactions in supernovae and the proposed experimental program of cross section measurements at the SNS will be presented.

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[2]For the *νSNS* collaboration (see http://www.phy.ornl.gov/nusns).